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CHANGES IN PULSE RATE SPEED IN LIMBS DUE TO AGE AND OCCUPATION

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CHANGES IN PULSE RATE SPEED IN LIMBS DUE TO AGE AND OCCUPATION

W. Wǎrbanov[1]

Rate of propagation of the pulse wave is considered one of the most important diagnostic signs of the state of elasticity of the arteries (refs. 1 and 2). In 1876 Resal was the first to deduce the equation $C = \sqrt{\frac{E.\varepsilon}{2\,ah}}$ (ref. 3). Here C is the rate of the pulse wave, E is the module of elasticity of the vessel wall, ε is the thickness of the vessel wall, a is the inner radius of the arterial tube, and h is the density of the fluid. /321*

The equation shows that the propagation rate of the pulse wave is proportional to the module of elasticity of the arterial wall. It follows that the rate of the pulse wave increases with hardening of the arterial wall and with increase of its module of elasticity. Many authors (refs. 2 and 4-7) observed an increased rate of the pulse wave with increasing age and with hardening and thickening of the arterial wall.

Beginning with the fact that the hydrostatic pressure is greater on the lower limbs than on the upper limbs during the course of human life, we set

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*Numbers given in the margin indicate the pagination in the original foreign text.

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ourselves the task of investigating the changes of the pulse rate in both areas, as caused by age and occupation.

We investigated 110 persons, divided into three groups: Group 1, 40 persons, barbers with over 30 years of working at this trade, 54-61 years old (average age, 56.6 years); Group 2, 40 persons, shoemakers, with over 30 years of work, aged 53-62 (average age, 55.8 years), and Group 3, 30 persons of younger age and various trades, 16-38 years old, with an average age of 22.8 years. In the persons of Group 1 the trade is connected with a great deal of standing and consequent heavy hydrostatic pressure on the vascular system of the legs, whereas the persons of Group 2 do their work in a low, sitting position, with very low loading of the vascular system of the legs by the hydrostatic factor. There is no statistically valid difference in the age characteristics of either group. We determined by anamnestic data and clinicophysical examinations that all test subjects were free of any cardiac and vascular damage.

We determined the rate of the pulse wave with an indirect method, /322 which had been used by I. Manuiloba (ref. 8) and F. Lebedev and J. Sternshnis (ref. 9) in determination of the interval between the R deflection of the EKG and the start of a pulse wave at a definite peripheral point. This quantity is actually not speed or rate, but the time interval of the propagation of the pulse wave from the aorta to a given peripheral point.

With this method we cannot determine the rate of the pulse wave in absolute values, because the length travelled by the pulse wave cannot be measured exactly. However, the changes in the time of propagation of a pulse wave, which are in inverse relaltion of the changes in the speed of the pulse wave, are significant enough in group examinations also to indicate changes of the rate of the pulse wave.

For our purposes we examined the third derivative of the EKG, at the same time registering the pulse wave at the arteria radialis and arteria dorsalis pedis of the right limbs by means of piezocrystall readings (fig. 1). A visiograph "Alvar" was used for registration and amplification. When taking sphygmograms the amplifier inputs were connected to 0.1 F block condensators (as auxiliary shutter resistance), in order to eliminate the small high-frequency oscillations of muscle and skin. Registration was done with a tape speed of 60 mm/se. Examination was done with completely horizontal position of body and limbs. The test subjects were well rested. In the statistical evaluation of the results we compared the time intervals between the R deflection of the EKG and the start of the pulse wave in the arteria radialis and arteria dorsalis pedis as well as the time differentials in the appearance of the two pulse waves.

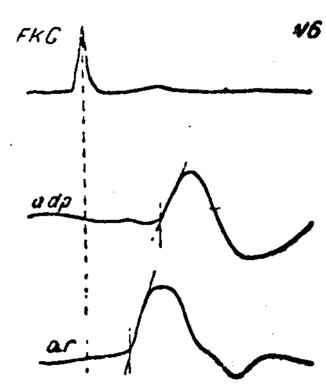

Figure 1. Electrocardiogram and pulse registration. EKG, electrocardiogram-III derivative; adp, pulse registration at the arteria dorsalis pedis; ar, pulse registration at the arteria radialis.

TABLE 1

	Time interval betw. R deflection and pulse wave in a. radialis (sec)		Time interval betw. R defl. and pulse wave in a. dors. ped. (sec)		Time interval betw. start of pulse wave in a. rad. and a. dors. ped. (sec)	
Group 1 (standing)	0.124	0.003	0.173	0.004	0.048	0.002
Group 2 (sitting)	0.130	0.002	0.194	0.003	0.064	0.002
Group 3 (younger)	0.144	0.003	0.239	0.004	0.095	0.003

The results of the examination are given in table 1.

The table as well as the results of the statistical analysis show the following in regard to the truthfulness of the differences.

The time of propagation of the pulse wave to the periphery is shorter in the group of older persons than in the group of younger persons. This completely agrees with the results of the mentioned authors (refs. 2 and 4-7), who proved increased pulse wave rates with increasing age. This age- /323 conditioned increase in the rate of the pulse wave is greater in the legs than in the arms. This explains the decrease of the time interval between the appearance of the pulse in the arteria radialis and the arteria dorsalis pedis which is 0.095 sec in the younger group and 0.64/0.48 sec in the two older groups. In Group 1 (working while standing) the decrease in time of the pulse wave propagation in the legs is more noticeable; this is also true of the shortening of time interval between the appearance of the pulses in the arteria radialis and the arteria dorsalis pedis.

These results permit the conclusion that the module of elasticity of the arteries in the legs increases with increasing age (because of hardening of the arterial wall) to a greater extent than is the case in the upper limbs.

This phenomenon appears even more clearly in the trades and occupations with higher hydrostatic loading of the vascular system of the legs because of standing, upright working conditions.

We further note that the method used by us for determination of the rate of the pulse wave, where the starting point was taken as the moment of bioelectric activity of the chambers and not the actual start of the pulse wave in the aorta, does have an error, but this was not of importance in our comparative investigations. E. Simonson and K. Nakagawa (ref. 10) determined that the time of ejection of the pulse volume from the left chamber--after the start of the chamber complex up to the appearance of the pulse wave in the aorta--increases with age. Under this condition the error in the comparison of the results for older and younger persons, which consists only of milliseconds, does not contradict our results, neither because of its insignificance nor because of the direction of its effects.

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